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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

DIAZ, JOSE R

ART UNIT

PAPER NUMBER

2815

DATE MAILED: 11/01/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/497,320	Applicant(s) GHAEMMAGHAMI ET AL.	
	Examiner José R. Díaz	Art Unit 2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11 August 2004.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,4-8,11,12 and 14-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 15-17 is/are allowed.
- 6) ☒ Claim(s) 1,4,5,7,8,11,12,14 and 18-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

In view of the appeal brief filed on August 11, 2004, PROSECUTION IS HEREBY REOPENED. A new ground of rejection is set forth below.

To avoid abandonment of the application, appellant must exercise one of the following two options:

(1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply under 37 CFR 1.113 (if this Office action is final); or,

(2) request reinstatement of the appeal.

If reinstatement of the appeal is requested, such request must be accompanied by a supplemental appeal brief, but no new amendments, affidavits (37 CFR 1.130, 1.131 or 1.132) or other evidence are permitted. See 37 CFR 1.193(b)(2).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was

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not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 4-5, 8, and 11-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hori et al. (US Pat. No. 5,320,974) in view of Wolf et al. ("Silicon Processing for the VLSI Era, Volume 1-Process Technology", Lattice Press, 1986, pp. 321-324), previously cited in the Office action mailed on May 6, 2003.

Regarding claims 1 and 8, Hori et al. teach a method for providing a halo implant in a semiconductor device comprising the steps of:

(a) providing a thin mask layer (MASK) to the semiconductor device (N + POLY-Si GATE) that covers a substantial amount of an active area comprising a drain region (DRAIN REGION) (see figs. 3-4)¹; and

(b) providing the halo implant (B+) (see fig. 3).

However, Hori et al. fails to teach a mask layer comprising photoresist. Wolf et al. teaches that it is well known in the art to use photoresist in place of SiO₂ as a mask. (see last paragraph of page 321 of Wolf et al.).

Hori et al. and Wolf et al. are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to use photoresist instead of a metal or an oxide film as the ion implantation mask material. The motivation for doing so, as is

¹ With regards to the limitation that the mask layer covers a substantial amount of an active area comprising a source region, it is noted that figures 3 and 4 show an enlarged sectional view of the drain structure (7b) of the MOS transistor disclosed in figures 1C and 2A-2C, in which the mask layer (8a and

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taught by Wolf et al., is that photoresist have good ion stopping power in the smallest thickness (see last paragraph of page 321 of Wolf et al.). Therefore, it would have been obvious to combine Wolf et al. with Hori et al. to obtain the invention of claims 1, 4, 5, 8, 11 and 12.

Regarding claims 4 and 11, Hori et al. teach that a halo implant angle of about 45° (see col. 6, lines 60-63).

Regarding claims 5 and 12, Hori et al. teach providing LDD regions (6a and 6b) (see Figs. 1A and 2C) before the halo implant (B+) (see figs. 1C).

Claims 7 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hori et al. (US Pat. No. 5,320,974) in view of Wolf et al. ("Silicon Processing for the VLSI Era, Volume 1-Process Technology", Lattice Press, 1986, pp. 321-324), and further in view of Thackeray et al. (US Pat. No. 6,037,107).

Regarding claims 7 and 14, a further difference between the prior art and the claimed invention is the use of DUV. Thackeray et al. teaches that it is well known in the art to expose the photoresist mask to deep ultraviolet (DUV) radiation (see col. 1, lines 35-38).

Hori et al., Wolf et al. and Thackeray et al. are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to expose the photoresist mask to deep ultraviolet (DUV) radiation. The motivation for further doing so,

8b) is also shown covering the source region (7a). In addition, Hori et al. teaches the use of SiO_2 instead

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as is taught by Thackeray et al., is that DUV exposure provides patterns of reduced feature size (see col. 1, lines 35-38). Therefore, it would have been obvious to further combine Thackeray et al. with Hori et al. and Wolf et al. to obtain the invention of claims 7 and 14.

Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Liang et al. (US Pat. No. 6,051,458) in view of Wolf et al. ("Silicon Processing for the VLSI Era, Volume 1-Process Technology", Lattice Press, 1986, pp. 321-324).

Regarding claim 18, Liang et al. teaches a device comprising:

a gate (22A) (see fig. 1C);

an oxide trench (14A and 14B) (see fig. 1C);

a drain region (24D) adjacent to said oxide trench (14B) (see fig. 1C);

a source region (24S) adjacent to said oxide trench (14A) (see fig. 1C), and

a photoresist layer (PR2) over said oxide trench (14A and 14B) and over a substantial portion of said source (24S) and said drain (24D) regions, wherein a halo implant (26') is implanted using said photoresist layer (PR2) and said gate (22A) as a mask (see fig. 1C). Furthermore, Liang et al. teaches that the boron ions (26') are implanted at an energy from about 15keV to about 50 keV (see col. 3, lines 35-37).

However, Liang et al. fails to teach a photoresist layer of a thickness between 0.1-0.2 μm .

of TiSi_2 as the mask layer (8a and 8b) (See col. 7, lines 44-46, and figures 3 and 4).

Wolf et al. teaches that it is well known in the art to implant boron ions by using a thin photoresist of, for example, 0.2 μm (Please note that figure 36b of Wolf shows minimum thickness of a photoresist material required to stop 99.99% of incident ions as a function of energy and of ionic type. For example, a photoresist of about 0.2 μm is required for stopping boron ions implanted at an energy of about 30 keV).

Liang et al. and Wolf et al. are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to use a thin photoresist of about 0.2 μm . The motivation for doing so, as is taught by Wolf et al., is to restrict the ionic species from being implanted into unwanted substrate regions (see last paragraph of page 321 of Wolf et al.). Therefore, it would have been obvious to combine Wolf et al. with Liang et al. to obtain the invention of claim 18.

Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Liang et al. (US Pat. No. 6,051,458) in view of Wolf et al. ("Silicon Processing for the VLSI Era, Volume 1-Process Technology", Lattice Press, 1986, pp. 321-324), and further in view of Thompson et al. (US Pat. No. 6,020,244).

Regarding claim 19, a further difference between the prior art and the claimed invention is implanting the halo implant at an angle of about 45 degree.

Thompson et al. teaches that it is well known in the art to implant at an angle of 45 degree (see col. 3, lines 18-19).

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Thompson et al., Liang et al. and Wolf et al. are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to further implanting the halo species at an angle of 45 degree. The motivation for further doing so, as is taught by Thompson et al., is improving punchthrough characteristics (col. 1, lines 40-41). Therefore, it would have been obvious to combine Thompson et al. with Wolf et al. and Liang et al. to obtain the invention of claim 19.

Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Liang et al. (US Pat. No. 6,051,458) in view of Wolf et al. ("Silicon Processing for the VLSI Era, Volume 1-Process Technology", Lattice Press, 1986, pp. 321-324), and further in view of Thackeray et al. (US Pat. No. 6,037,107)

Regarding claim 20, a further difference between the prior art and the claimed invention is the use of DUV layer. Thackeray et al. teaches that it is well known in the art to expose the photoresist mask to deep ultraviolet (DUV) radiation (see col. 1, lines 35-38).

Liang et al., Wolf et al. and Thackeray et al. are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to further expose the photoresist mask to deep ultraviolet (DUV) radiation. The motivation for further doing so, as is taught by Thackeray et al., is to effectively activate the photoactive component of the photoresist system (see col. 12, lines 60-62 and col. 13, lines 1-6). Therefore, it

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would have been obvious to further combine Thackeray et al. with Liang et al. and Wolf et al. to obtain the invention of claim 20.

Allowable Subject Matter

Claims 15-17 are allowed.

The following is a statement of reasons for the indication of allowable subject matter: the prior art fails to teach, disclose, or suggest, either alone or in combination, a method comprising the steps of providing a first photoresist of a thickness 0.55 μm or greater over an oxide of a semiconductor device; providing a lightly doped drain implant; removing the first photoresist; providing a second photoresist layer of a thickness between 0.1-0.2 μm over the oxide trench and a substantial portion of a source and drain region; and implanting a halo implant using the second photoresist layer as a mask.

Response to Arguments

Applicant's arguments with respect to claims 18-20 have been considered but are moot in view of the new grounds of rejection.

With respect to claims 1, 4-5, 7-8, 11-12 and 14, Applicant argues that if Wolf and Hori were combined, the device of Hori could no longer function. However, this misunderstands the rejection. As applicant points out, Hori does disclose a device using TiSi_2 as a mask. However, Hori also teaches an embodiment using a SiO_2 mask, which is the embodiment used in the rejection as repeated above. Hori does not

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expressly teach the use of photoresist as such a mask, but Wolf makes obvious the use of photoresist in place of SiO_2 as a mask. As such, the claims are considered obvious in light of Hori in view of Wolf.

In further arguments, applicant also states that evidence must be supplied to show the ion stopping power of photoresist as compared to TiSi_2 . Again, as pointed out above, this argument misunderstands the rejection. Hori teaches the use of SiO_2 as an ion implant mask and shows distinctly in figure 3 the resultant ion implant profile when using SiO_2 as a mask. Wolf teaches that photoresist is a known material substitute for SiO_2 and also provides two graphs, e.g. figures 36(a) and 36(b), teaching ion implantation energy versus thickness for SiO_2 and photoresist, respectively. As taught by Wolf, both SiO_2 and photoresist have the ability to stop 99.99% of ionic species for a given thickness (which thickness are within the range as claimed later by applicant). In all, a comparison of TiSi_2 and photoresist is not necessary.

Regarding the use of Thackeray, applicant argues that evidence must be supplied to show the ion stopping power of photoresist as compared to TiSi_2 . However, as pointed out above, a comparison of TiSi_2 and photoresist is not necessary. As such, the argument is not convincing.

Finally, applicant attacks the combination of Thackeray Hori and Wolf, stating that the combination will destroy the function of Hori. However, as pointed out above this argument is not convincing, as the function of Hori will not change as a result of the combination.

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Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Correspondence

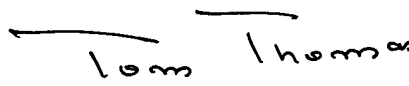
Any inquiry concerning this communication or earlier communications from the examiner should be directed to José R. Díaz whose telephone number is (571) 272-1727. The examiner can normally be reached on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (571) 272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JRD
10/28/04


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